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EDITORIAL.

ALTHOUGH as an Institution our chief aim must be to serve the community by advancing the science of production, this is in no way incompatible with a general desire on the part of members to raise the status of the production engineer himself. At present commercial men, particularly salesmen, etc., enjoy a status (and salary) out of all proportion to that accorded to technical men and production engineers. It is interesting to enquire the reason for this state of affairs. Is it that our methods of production are still relatively so inefficient that men who can sell the finished product are comparatively rare and can therefore demand a high salary? Or is it merely that the salesman, better versed in the art of selling, can obtain a much higher price for his services than the engineer who, proverbially modest, hides his light under a bushel? Alternatively, is the reason to be found in the lack of vision on the part of manufacturers who concentrate on the distributing and selling organisation rather than on the perfection of the product and methods of manufacture?

Each of these causes may contribute something to the present disparity between commercial men and technical men, and whilst the remedy is not entirely in our own hands as production engineers, we can at least do something to bring about a more desirable state of affairs by concentrating on production until we can manufacture so cheaply and efficiently that the product will find a ready market without the need for a costly selling organisation.

Discussion on Mr. J. T. Kenworthy's Paper Entitled "A Simple Works System."

THE PRESIDENT, in opening the discussion, said that he thought Mr. Kenworthy was to be congratulated on his paper. He was particularly pleased to hear him emphasise the need for simplicity. The more one came into touch with progress systems the more one realised how a really ingenious method was liable to fail because it became too cumbersome. Little additions were made here and there until by degrees the original conception of the system became entirely buried in the various offshoots and branches which grew from it.

Mr. Kenworthy was also to be congratulated, inasmuch as he had given a description of a definite system for a class of work which formed quite a large industry in this country, namely, motor car work. It was, of course, obvious that a progress system suitable for continuous production of one product, although of many types, might conceivably be unsuitable in a works where production consisted of many different products. There was, however, one underlying principle which should be observed in all systems, *i.e.*, from the time material was issued to the shops to the time it reached the finished state, one must be able at any point to determine the state of affairs as a whole, and the position which the work had reached. This was a feature which the system described certainly seemed to possess.

There was one point, however, which struck him as not quite complete, or effective, and that was the colour scheme which denoted to the shop foreman the time when parts were wanted. It would appear that where parts pass through a long sequence of operations, the only foreman to whom the system was not really of use would be the one doing the last operation, and that as far as the colour scheme was concerned, so much reliance might be placed upon the colour by the foreman doing the previous operation that the last one to receive the work would probably get it so late that he had to go all out to complete the work in time. If the progress through the shops could be watched and known to the man responsible for progress, instead of by the foreman, so that each foreman acted under the instructions of the progress man at the central office, this risk would be avoided.

He was impressed with the idea of slogans in the shops for showing the advantages of inspection during operations. These slogans might be much more widely used in factories than at

present. They were a very good way of penetrating the skull of the workman.

He also gathered from the paper that the planning department, the rate-fixers, and the jig and tool design section were three self-contained departments isolated from each other to some extent. It had always been his view that it was very important to have these three departments under one control. It was difficult for the planning man unless he knew how it was suggested that the job should be tooled up, whilst it was equally impossible for a ratefixer to fix times ahead unless he also had a good idea how the job was to be tooled. In this case he presumed that jigs and tools had to be designed before the job was passed to the rate-fixer.

There was one other point upon which no information was given. The progress department were responsible for issuing material to the shops. Presumably the shop would not be laid out in such a way that every part could be produced simultaneously, therefore the work must be issued to the shops in some sort of rotation. He had not seen any method of advising the progress department as to the state of work in any particular section so that they could look ahead and keep the work going regularly through the various departments.

MR. KENWORTHY, replying to Mr. Hutchinson, said that possible trouble with the colour scheme on account of foremen taking jobs in the wrong rotation was to some extent obviated by the system of index figures which he had mentioned. Long operation jobs were issued to the shops before the shorter operations. By means of the index figure the jobs with the fewest operations went out last, so that there was a certain sequence in which jobs were issued to the shops. He had mentioned in the paper that reliance was not placed on the colour system alone, but at the same time it provided a definite aid because the dates were given and the colours indicated the particular date on which each job must be completed. Moreover, it must be considered that foremen, although they are human, would not hold their positions of responsibility if they did not possess some knowledge as to how long it took to do the later operations, and they found that the foreman did recognise that there were subsequent operations to be done in other departments.

Regarding the question of the drawing office, rate-fixing and planning departments, he would not dispute Mr. Hutchinson's statement at all, because it was an ideal arrangement. He would mention, however, that one was frequently handicapped by the original layout of the shop in introducing a system which would be a satisfactory proposition. In this case the rate-fixing office and the planning department were next to each other, and although they were not actually under one control they were work-

ing hand in hand. Unfortunately, the tool drawing office was removed from them, owing to the fact that in the original layout of the plant the tool room was located at a remote part of the building.

The amount of material actually in hand in any particular department could not be seen at a glance by reference to any information which was recorded in the progress department, but it was found that the foremen very soon let the management know if there were any shortage of material. As the plant was at present laid out, machines had been added in each department from time to time in such a manner that they were more or less in a fairly well balanced condition, so that a regular flow of material issued at intervals kept the machines uniformly occupied. Any slackness of work was first evident in the capstan lathe and similar sections that took the first operations, and this slackness gradually went through the works up to the grinding department. He could not recollect any instance where one department was without work whilst others were fully occupied, except during slack periods, when the shortage of work affected all departments in turn.

Mr. Gerard Smith (Member) referred to Mr. Kenworthy's remark at the beginning of his paper to the effect that simplicity was the chief objective in shop control methods. Without any intention of being personal, he really thought that he had never seen such a colossal number of forms in one works to control any product. This admittedly was, to a certain extent, due first of all to the existing building, and, secondly, to what he considered was a fallacious outlook.

In the first case he did not consider a five-storey building to be suitable for such work as that being carried out. The carriage costs from one department to another must be great, and there were other difficulties One was that, whilst the plant in such a factory was a fixture, it was possible in the single-storey works to change it about. The same applied to the situation of the offices. He had been for quite a number of years in one of the factories in the country which was looked upon by some people as being over-organised, where this point was illustrated very well. A certain product was handled as a mass production job in one shop, and another in another shop. If any plant were required in one shop which was not in that department it was a question of change it over. Similarly, if an office were unsatisfactory in its existing position, then by the end of the dinner hour it was in the position required. The five-storey building, of course, made such mobility almost impossible, but personally he would not permit any awkward arrangement of plant by a predecessor to stand in the way of organisation in the slightest degree.

Referring again to the number of cards and records, the main

requirement in production was to cater for construction and assembly. Here one had an operation card, a production card, a shop order, a progress quantity card, a clock card, an inspection report, a master operation card, a monthly manufacturing order, a unit assembly order, and an assembly instruction which was the one mentioned first. Admittedly these all served different purposes, but one should concentrate on those in which the fewest entries occurred. For example, on the clock card. Many of the other cards meant numerous clerical entries with an increased possibility of clerical error, and even so many of the cards were incomplete. This applied, for instance, to the operation card. In connection with this he would like to put forward a suggestion. One had to make a drawing of all the parts to be produced, and there was no difficulty at all in producing a tracing of that part with all dimension lines but no figures. Then for six operations there was no difficulty in producing six blue prints on each of which the dimensions concerning the respective operations would be entered. On the drawing, or on the bill of material if preferred, could be entered the material to be issued with a list of the jigs, fixtures, gauges, etc. Then the production man or the progress clerk could be made responsible for collecting for that operation the drawing, material, jigs, tools, and everything connected with it. Mr. Kenworthy had mentioned, for instance, that an operator could get his tools on demand. The operator should not have to demand anything, but before he has finished one job the next job should be waiting for him together with material, jigs, tools, etc. Every moment that an operator spent away from his machine was time absolutely lost from a production point of view.

With regard to the difficulty of obtaining papers in the necessary colours, he (Mr. Gerard Smith) thought that possibly he could be of some assistance to Mr. Kenworthy, because in his firm they were concerned with producing cards in several millions a week, so that they had been up against the matter pretty seriously. They had solved the difficulty in the following manner, and he did not see why any ordinary printer working on a rotary press should not adopt the same method. The first operation on the cards with which they were concerned was to slit them into the required width. To get the desired colour, all they did was to put an aerograph spray over the card as it came from the slitting machine. The spray could be coloured with any aniline dye one cared to use, so that there was no reason why one should not have fifty colours from a single roll of paper so long as it was possible to distinguish them apart.

With regard to the special urge sheet, he had occasion to deal with this matter. Instead of using a special sheet, all orders which were particularly urgent were marked with stars—blue,

bright red, or green—which were sufficient to distinguish them instead of making another clerical entry.

With regard to the arrangement of the jig and tool office, planning department, and the production engineer's department, he had always been in favour of them being in one office under the control of one man. Co-operation must be so close that there was no possibility of separating these departments.

Finally, he noticed in connection with the system there was no date planning. When, however, the commencing time or the time for completion of any particular job was of importance, it was not usual to rely on the foreman to put the job in hand at his discretion, but to give him the actual date and time, stating, for instance, that it should be put in hand at 12.30 on Wednesday, and should be completed by, say, 5.30 on the same date.

In reply to Mr. Gerard Smith, MR. KENWORTHY said that in the actual working of the system it did not prove so colossal as might be apparent from a description of the various uses of the different forms. He did not think the amount of clerical work was very great, and yet it was possible at any time to refer back to the whole history of the component or unit. The actual amount of clerical work involved could be gathered from the fact that out of a total number of approximately 500 employees the staff of the progress department, including chasers, clerks for requisitioning material, etc., was only eight. The method of entering operations on the blue print had been tried, but in connection with this the last speaker was evidently under the impression that, because they were dealing with a chassis assembly, it was a straightforward proposition involving two types at the most. They were, however, in the unfortunate position where they had to produce a multitude of types. To adopt the method suggested under these circumstances would involve a tremendous amount of clerical work and work in the drawing office.

Another reason why they had not adopted this method arose from the fact that drawings were continually being altered with the object of cheapening production. He did not know whether it was the experience of members generally, but he certainly found that the draughtsman who designed the parts did not always know the actual limits which should be fixed for the job, and it frequently happened that the limits had to be fixed in the works. Actually, of course, limits should be fixed beforehand, but in any case such things as drawing alterations were common, and as time went on it might be found desirable to alter the methods of operation, which involved changes in planning, new jigs, etc., and in such cases it was much more difficult to alter the main component blue prints than it was to alter a few cards.

With reference to the question of issuing jobs and obtaining suitable colours for the cards, it was mainly a matter of getting

distinctive colours. They were unfortunate in that they had no means of colouring the cards themselves, but they had thought it best to adopt four distinctive colours. After all, the more colours there were, the less distinction there could be between them.

Whilst he quite appreciated the remarks of the last speaker with reference to date planning, he thought that could only be carried out if the job were on a mass production basis with a large number of machines for comparatively few operations. If, however, one had machines that were not employed on the same job more than once a week, or once a month, or if the machines were occupied with thirty or forty operations in the course of a week, there would be a tremendous amount of work involved in date planning. Moreover, difficulties would arise as soon as one happened to be let down by some supplier not supplying material to time, or as soon as one came across a batch of very hard material to machine, and this would involve a tremendous amount of work to change over the times and straighten the matter out.

Mr. A. Willmott (Member) said that he thought they would all support the President in thanking Mr. Kenworthy for his very able paper. A paper such as that given always elucidated some question and some query on points on which the various speakers could not be in entire agreement. With regard to the colour scheme put forward in the paper, he was of the opinion that in the majority of works up and down the country this was used in some form or other, although preferably for purposes of distinction rather than to indicate time. In one works with which he was acquainted, for example, anything connected with repairs had a yellow card, which was distinctive and known throughout the works as an urgency job. Again, in many shops there was a subdivision of orders under such headings as "Customers' Orders," "Stock Orders," or "General Production Orders," all of which required a distinctive colour. He thought it very much better for orders when issued to have the date of the issue and in addition the completion date inserted. This would then be a guide for the foreman and for the progress departments in taking charge of special orders once they were issued from the works office.

Another point in the paper was in regard to assembly, as it seemed rather a weakness that assembly should take the place of batch work, and that the assembly shop should become a part stores. Perhaps he had misunderstood the paper, but it seemed to him that what was required was an allocation stores, which had proved to be the true solution in so many other works. In the assembly shop where the assembly order was issued, the allocation storekeeper took charge of it. He then requisitioned the required parts from the other stores, wherever they may be, and in some places requisition was made in the form of a shortage

sheet which indicated immediately the parts that were required before the assembly shop could proceed with the work.

One point in the paper on which he would be glad of further information was in reference to determining the exact progress of work which was going through the shops. The production engineer was the man who needed to have before him the progress of each individual part that had been issued, or any group of orders, so that he could grasp the position at any particular moment with as little attention to detail as possible.

In reply to Mr. Willmott, MR. KENWORTHY said that he thought the colour scheme mentioned did really give a distinction to the particular batches rather than a time distinction as mentioned by the last speaker. The date of issue was entered on the cards and the date of completion was, of course, the date on which that particular colour was due to be completed.

With regard to the issue of the material to the assembly shop, this was issued to a service stores which in effect was only another name for an appropriation stores. The material was gathered together in the service stores by a storekeeper and issued to the assembly shop in sets, one set of parts for engine assembly, or a number of sets in the case of smaller assemblies such as a batch of cylinders. The object was to collect the whole of the material in the service stores prior to issuing it for assembly. It was, therefore, only a question of terms. The works manager issued instructions as to the number of units which were to be manufactured and the number which had to be covered. No units whatever were actually issued for assembly except on his authority, but in conjunction with him the progress departments issued at intervals batches of units which the works manager authorised by his signature. Thus he knew what was actually in progress as well as the actual number of units of the particular batches which were completed. There was, however, no actual record of the position from day to day, although the works manager had a report weekly. That was a point which he had omitted to mention in the paper. Every week the number of units built and the various types were recorded on a sheet by the progress department under such headings as Engine Assembly, and other units, and this sheet was submitted weekly to the works manager. It was made out to cover a four-week period, which was the basis of the system, so that at any time during the four weeks the manager had that particular chart to refer to, and he could always obtain information as to the position during the current week at a very few minutes' notice.

MR. W. E. GANNON (Member) said that as production engineers they had probably all come into contact with the type of man who introduced works systems. They had seen one man come and go again, and when another individual came along they had

seen the previous system vanish as quickly. Every new system introduced was supposed to be the last word, but personally he confessed that he had not seen what he considered a really efficient system. This might suggest that he was opposed to system, but whilst this was far from the case he certainly thought the system described by Mr. Kenworthy carried them back to the days of their mathematical studies when before they could arrive at a solution they had to simplify things. It was not for him to criticise, however, as he appreciated everybody's efforts to promote an enlightened idea of production at a comfortable rate and in the most convenient and most profitable way. He would like to ask, however, who really benefited in the most direct sense by the various types of cards that were issued and deemed essential for Mr. Kenworthy's system. If they went into the production departments, did the shop foreman repeatedly have to refer to them? In his opinion the foreman was best employed when he was about in the shop actively supervising the work. Again, when the cards had been filled in were they summarised? And were any steps taken to ascertain if work were too costly in production, and was there any systematic attempt to bring about a continual reduction in the cost of producing? Moreover, what really became of the cards in the end? Did they form a basis for compiling a summary card for some specific object? He would be glad if Mr. Kenworthy would explain what was the main object that the number of cards stood for.

Mr. Kenworthy, replying to Mr. Gannon, said that the first card was the shop order, and was the only card which got into the shops. Again, it was the only card to which the foreman need make reference. The clock card was, of course, a record of the number of hours recorded on the job, and was kept and filled in by a time clerk. That or some similar method for recording the cost of a job was necessary to ascertain the piecework due to any individual. The production order was the record which the cost office required in connection with the work that was being done on a particular batch. The progress quantity card was the only permanent record which the progress department kept of the jobs when they had been issued at any time. The monthly manufacturing order was required entirely for costing purposes, and was sent on completion of the job to the cost department. The unit assembly card was filed for reference for a certain period, and the schedules, of course, were permanent. They were permanent after they were issued for any particular type. The question of cost was closely watched by the rate-fixing department in conjunction with the cost office. The last-named department quickly reported to the shops if any particular batch of work had gone through at a higher rate than the average cost, whilst if any job worked out at a loss the rate-fixing department

made immediate investigations. As a matter of fact, the rate-fixing department were called into consultation by the foreman if any trouble arose on a particular job on which piecework time was considered unsatisfactory.

Mr. Oakley (Member) said he had listened with interest to Mr. Kenworthy's paper, and felt that the system which had been put before them met the case in question very well. The questions which had been asked in connection with this particular system were all those one would quite properly expect. Every firm adopted the system which suited them best, and he thought the system to be employed in any particular case must be left largely to the concern itself. In the eyes of outside people there were always bound to be faults.

The remarks which had been made relating to costs were very interesting. As in all works systems, obviously, the object was to keep the costs right, in relation to the selling price, and he was of the opinion that too great an emphasis could not be laid on that point, *i.e.*, the ultimate result of any system should be to obtain satisfactory costs and to maintain such. This question seemed to be always in view in the system which Mr. Kenworthy had described, but he felt that there should also be some collective record kept which covered the cost office, the production engineer and the rate-fixing department, so that the works manager would always have at his command records which would enable him to deal with any items of cost that might arise. The rate-fixing department could only deal with certain aspects of the matter because many items of cost were largely affected by outside supplies. Frequently it was not only manufacturing costs which affected the ultimate costs, but these rested also with the purchasing department and depended on such matters as the quality of the material, on castings and stampings, etc., over which the production engineer and the rate-fixing department had little or no control. He thought they had had the opportunity of examining a system which would prove exceedingly valuable on certain classes of production work, although on mass production lines there might, of course, be an opportunity of getting down to a much more concise system. The more the product was specialised the better the system could become, and, on the contrary, the more diverse the product the more difficult it became to evolve any really satisfactory system. Personally he had had great pleasure in listening to the paper.

Mr. Gerard Smith said that he rather wished that their late Hon. Sec., Mr. A. T. Davey, had been present, as most of them knew he was now at the works of Messrs. W. H. Allen & Sons, Ltd., at Bedford, and he recently had the pleasure of going over their establishment. In doing so he noticed in their progress section, which was a combined progress, recording and rate-setting

department, that there were, unless he was mistaken, scarcely more than ten clerks to control the whole of the works departments, which employed somewhere over 2,000 hands. The class of work, however, was perhaps as difficult as any, as there were never two jobs in the shops alike, and very seldom were there two products absolutely identical. The main product was oil engines, which, to a certain extent, were repeated, but designs were continually being modified. Then there were condensers and pumps, which were made to customers' specifications, which naturally varied continually, but, in spite of this, the whole of the clerical staff throughout the entire factory, including costing, time booking, etc., was probably not more than twenty clerks, yet they were time-planning every component and costing every part throughout the entire works.

Mr. Hey (Member of Council) referred to the criticism which had been made of the number of forms in the system described. He had had a fair experience of such systems, and in his opinion there were two other forms which should be included, in addition to those put forward by Mr. Kenworthy. One related to the departmental output. He thought that each departmental foreman should be supplied with a monthly list of the work that was to go from his department. Moreover, this list should be made in sequence form, so that the job which was required to go out first should be at the head of the list. The foreman then had definite information of the amount of work that was expected from his department. The list to be issued monthly by the progress department. The list or form on which this was entered should also give the number of man hours per machine and the number of machines in commission.

The other point was the question of reducing costs. That required a form which was extensively used throughout the country, namely, a cost analysis form. One form is used for each component, and on this form each operation cost is entered in column rotation for each batch or sanction put through. By scanning up the totals of each line or batch, a comparative cost is obtained showing whether the costs are decreasing or increasing. If piecework or premium system is used, the "Bonus" column, or "Hours saved" column, will give this information. Now it happened to be his good fortune to be well in touch with the system that the previous speaker had described, and he did not quite agree with him on the subject of administrative costs. Costs might be reduced in one section, namely, main office, but the total cost was distributed over a large number of works departments in addition, and to his knowledge at the time there was a clerk in every department, who also took charge of the progress stores in his particular section. Another point not mentioned was the transport, which in this works was one of the most efficient that he had seen

in this country. This subject in many works had not received the attention it deserved, and even in small works great economies could often be effected by introducing a system of transport of material and finished parts to the various machines, fitting and erecting shops, and stores. At the same time, he did not wish to criticise in any way, because the system described in the paper was certainly most successful, and, moreover, the firm obtained the output. It only went to show that one could not judge any system from outside, or adapt one system to another works; it must be taken on its merits. They would, however, find the cost analysis sheet of great utility, since it showed any increase or decrease in the cost of any unit on the card. Moreover, it proved exceedingly useful in firms who were constantly quoting for a modified class of product.

MR. KENWORTHY, replying to the last speaker, said that it was always difficult to make fair comparisons, since local conditions must always be taken into account when establishing any system. Comparisons were odious, and the only reason he had mentioned the number of people actually employed in the progress department was to answer the criticism that the forms were very numerous. If in proportion to the amount of work the forms were numerous, the clerical labour involved would require an enormous staff to cope with it. But this was not the case. He quite agreed that one could not give the foreman too much information regarding the amount of work that was expected from him, and that he should have the information in advance. On the other hand, there was, to a certain extent, the danger that he might get rather too involved if he had a great variety of work, so that it would actually take him more time to sort out what he had to do than to go straight forward with the work. He had not mentioned the question of cost analysis, because in their case it was not actually a part of the progress system. The analysis was made, however, by the works office, who kept and recorded the cost of every batch of material which went through the shop. For this purpose the special method of issuing job numbers had been introduced, and it was only since this had been done that the analysis had been maintained so that the cost of consecutive batches of components could be seen at a glance. The analysis was printed in such a manner that one could see at a glance comparative costs of at least twelve batches of components. This was available for reference at any time to the production engineer and those responsible for works costs, but if there should be any job which unduly increased in cost for any operation, then those responsible were immediately informed.

MR. W. E. GANNON said that whilst Mr. Kenworthy had answered his question as to the real object of the cards, he anticipated that it would lead to a different answer. Perhaps he could

make his meaning clear by describing what had actually taken place in his own experience. When he was manager of a department some years ago he had instituted a graph in the shop office. This was ruled for fifty-two weeks, and showed the rate of production of the principal jobs that were going through. After a very little while it became the ambition of the shop staff to observe an increase in the rate of production, although labour was supposed to be on the decrease. Scrap was eliminated, the amount of labour employed was less, but production was always going up, and the method seemed to create an incentive for everybody to do the very best. This was effected by a simple, direct method of recording in a graphic way what was happening week by week. Do Mr. Kenworthy's cards present the necessary information for this purpose, and is the information placed in such positions and used to such an extent that they provided the same incentive? That was what he had meant when asking the real object of the cards. They could not offer too much incentive for increasing efficiency and reducing costs of any manufacturing concern in these days of keen foreign competition.

MR. BASS said he thought they would all agree that the system had yet to be devised whereby one could say with certainty that a particular component would be in the stores when required. He would like to ask Mr. Kenworthy whether he thought it possible to run a system whereby one could say definitely that on a certain date there would be a certain number of components in stock, not one part alone, but whole sets of parts taken collectively. With regard to planning and progress systems, he had always understood, although perhaps he was wrong, that the progress system was the old-fashioned way of doing things. The planning system had really been drawn into a qualified progress system. It would be found that, in planning, an attempt was made, as far as possible, to plan work with regard to machines so that it passed into stock on certain dates, but one always found in addition a large number of men chasing these jobs about and getting them into stock. This should not be necessary if the planning were efficient and if accurate information were available regarding machine hour capacities, jigs and tools, etc. Should it not be possible to allow for little discrepancies that might creep in so that one could forecast with certainty that the job would be in the stores at a given time?

MR. KENWORTHY agreed with the speaker that it was very difficult to say that any particular job would be in a certain place at a certain time. There were so many eventualities likely to occur that, whatever the nature of the product, it would involve a considerable additional amount of clerical work to carry any such system through. He was of the opinion that the unit system most nearly approached the ideal when the whole of the machining

operations on every component were divided up to take a given period of time. That, of course, was possible with mass production where there were a comparatively small number of types and a definite basis time for each operation could be fixed. When this was the case it might be possible to say that a certain job would go on to a certain machine at a definite time. Against this he would like to point out that in the system described the object was to enable as far as possible for the work to go through the shops in an automatic and orderly sequence. In nearly every case the system had this effect, but there were jobs which had to be pushed forward. For example, if some mishap occurred to a jig a job would get delayed whilst the jig was repaired, or some alternative provision made for carrying on with the job. He was of the opinion that the whole question of whether it was politic or practicable to time date every operation in advance depended entirely on the nature of the work and the operations which had to be carried out.

MR. BASS asked whether Mr. Kenworthy would define the difference between progress system and planning system. Were they really two separate systems, or was it possible for one to take the place of the other.

MR. KENWORTHY said that the planning and the arrangement of the sequence of operations was, of course, done by the planning engineer, but after he had done this the routing of the job or urging them through the shops was carried out by the progress department, and in the system described was done automatically to a large extent by the system itself aided by the special urgers or chasers.

The PRESIDENT, concluding the discussion, said he thought that his previous remark, that it was impossible to have one system to fit every case, had been very well substantiated during the evening. Their view of progress systems must be governed by those with which they had personally come in contact, and these in turn were governed entirely by the products which they were designed to control. During the evening such things as oil engines, pumps, and condensers manufactured in ones and twos had been mentioned, also ball bearings manufactured in tens of thousands. It was perfectly obvious that a system which would look after the ball bearings could not be expected to be suitable for oil engines, etc. It was thus necessary to regard a paper of this kind as a description of a system for a particular purpose. As he had said before, he had had considerable experience from the earliest days of progress departments, and he considered the system described to be one which fitted the case very well. In the majority of systems one would find many extraneous diagrams and cards which were unnecessary for the main purpose for which the system was devised.

With regard to the method of preparing a separate drawing for every operation, he would like to emphasise once more the futility of trying to lay down general rules which should be applicable to every type of product. He could cite instances of five parts which had operations ranging in number from 73 to 136 on each. They could easily imagine the number of drawings and the colossal drawing office staff which would be required to prepare a drawing for every operation in such cases.

In conclusion, he would like to express the thanks which he was sure they all felt to Mr. Kenworthy for giving such an excellent paper, and for so ably answering the various points raised in the discussion.

MR. KENWORTHY, in acknowledging the vote of thanks, said that it had been a pleasure for him to give the paper, and if anybody had derived either pleasure or profit he would be only too pleased. He could assure them that he had been thoroughly interested in the discussion, and even if some of it had been in the form of adverse criticism he appreciated that also. It was a great mistake for any of them to go about with the feeling that they knew all that was to be known, and there was nothing left for them to learn. They were all out to learn and all the points mentioned had to be seriously considered and applied by everyone to their own individual use. He thanked the members very much for their appreciation.

INSPECTION METHODS.

By Mr. A. Butler (Member of Council).

IN choosing this subject for our debate this evening I fully realise that it is one which can only be dealt with on very general lines in the time at our disposal. I have not prepared any lantern slides for illustration, as I prefer to keep to the general principles of the subject rather than to enlarge on any special system of gauging, types of gauging apparatus, or methods of fixing tolerances.

I am going to assume that for the purpose of our discussion we are concerned with factories which are manufacturing small or medium sized work, such as electrical accessories, small motors, and various types of instruments. There is a lot of this class of work being done, and the work is very often of a highly competitive nature, and the quantities to be produced are usually large enough to allow for the necessary time to be spent in laying out of proper methods of manufacture, and as the work has nearly all to be done by unskilled labour the inspection of the various components will largely govern the cost of assembly and final testing.

There seems to be a distinct tendency on the part of a number of firms to regard the Inspection Department, other than for final test, as being somewhat unnecessary, and it is too often the first department to be drastically reduced immediately there is any sign of a slackening trade.

Personally I do not believe in spending any more money than is absolutely necessary on any non-productive work, but I do feel very strongly that the Inspection Department, if properly organised, and especially if well supervised by a broad-minded individual who thoroughly understands the product he is dealing with and who does not call for unnecessary accuracy on parts when it is not needed, is a most essential part of the organisation, if reliable and consistent results are to be expected.

In considering the minimum amount of inspection required for a given product there are many points to be determined before a system can be laid down, the chief points being :—

(1) The plant available for production.
(2) The accuracy required and the quantity and fixing of limits.
(3) The class of labour available.
(4) The amount of money that may be spent on tools, gauges, etc.
(5) The raw material to be used.
(6) The system of inspection to be used.

In considering the plant available I think that in every case where the manufacture of a new line is contemplated the Production Engineer should be consulted as to the suitability of the plant,

for although we consider ourselves a very resourceful body, the production of accurate work on old-fashioned and badly worn machines will never be economical even if it is successful.

My experience has been that the safest method of economising inspection is to make sure that the tool equipment and layout of the work in the early operation is capable of keeping well inside the tolerance allowed.

It will also have to be considered whether the plant available will allow the work to be kept running until the job is completed with a minimum number of set-ups, as of course we are all aware of the trouble and bad work caused by continually changing over jobs on the machines.

In considering the accuracy required, I think that we must also consider fixing of tolerances and also the dimensions on the drawing in general. I have frequently found that on looking at a drawing there appears to be quite a reasonable tolerance, but on checking up a few dimensions they have been so placed that the tolerance is actually negative, and for this and other reasons I am very much in favour of making the duties of a Chief Inspector to include that of checking the limits and dimensions of the tracings before they are printed and issued to the shops. This also gives him an opportunity of deciding what gauges will be required, if the quantity to be produced will warrant the making or buying of gauges.

With regard to the fixing of tolerances and limits, I have usually found it best to avoid the generally well-known system of fits, standard holes, etc., and to fix the maximum tolerance that job will stand, and then insist on it being adhered to. This allows very fine limits to be used when required and easy limits for the more unimportant dimensions, without upsetting the standard system if one were to be generally used, and on the class of work I have in mind this has proved very satisfactory.

We now come to the class of labour that is available, and as this is usually quite unskilled or semi-skilled, we at once come to the need for inspection in some form or other, whether it is in the machine shop or assembly department, and although it has often been urged that the foreman of the department, with the help of his charge hands and setters, should be responsible for the quality of the work, it must be admitted that a foreman in a busy shop cannot spare the necessary time to continually check the work from his machines, and it will be found more economical to use his knowledge and experience to arrange the flow of work through the department so as to produce his work at a minimum cost to the required schedule, and give him the help of a competent inspector or a system of inspection to ensure the quality of the work being kept up to the required standard.

The same remarks will apply to the assembly department if

unskilled or semi-skilled labour is employed, as in most cases even selection assembly cannot be entertained if the work is of a highly competitive nature, and steps must be taken to make sure that all the parts will go together quickly and easily.

I shall deal with the system of inspection to be used later, but I would mention that there will always be a small percentage of defective small screws, nuts, and similar parts that cannot be inspected 100 per cent., find their way on to the assembly bench, and rather than quibble with the Inspection Department about such parts it will usually be found much cheaper to issue, say, 2 or 3 per cent. extra of such parts and throw the defective parts out and scrap them, as the trouble of making out change notes and the delay caused to the operators is usually far more costly than the parts are worth, and if it is suggested that such parts should be thrown out by the Inspection Department, it will soon cost more to inspect than to machine.

The next point to be considered is that of the amount of money that may be spent on tools and gauges, and this will have a lot to do with the amount of inspection to be required, for given a reasonably good plant and a really good tool equipment, the work should be produced to such a standard of quality that only a very little inspection will be necessary, especially if there is a good supply of gauges for the important dimensions, so that they can be used as part of the operation. This, of course, can only be done where the quantity to be produced is sufficient, or in the case of a job that is frequently repeated.

For short jobs it is not generally possible to spend much money on special tools and gauges, and standard tools and micrometers, etc., will have to be used. This brings the human element more into the picture, and the Inspection Department will have to be more alert.

Another point that is not taken seriously enough is the class of raw material used, and neglect of inspection in this stage is quite frequently the cause of serious troubles in the later stages.

For the work I have in mind there is very little material required other than the ordinary standard qualities, so that no elaborate apparatus will be required, but there is no doubt in my mind that not a foot of raw material should be passed into stock unless it has been inspected, even if we admit that in many cases it is a visual inspection, a check against the purchasing department order, and a note of the name of suppliers.

Any material coming in from a new source of supply should always be specially notified to the Chief Inspector, who can then see that a more thorough inspection is made until he is satisfied that the supplies are consistent and satisfactory.

This is particularly necessary when material is being bought at cut prices, as although £2 or £3 per ton reduction in the price

of material sounds very attractive, it does not take long to spend considerably more than this to machine it, and when the overhead charges are added and the additional scrap is considered it can easily be appreciated that cheaper material was by no means *cheap*.

The inspection of raw material when applied to castings is more important, especially if multiple patterns are being used, and a quick visual inspection will usually be found well worth the trouble and cost involved, even though the castings are made from your own patterns which have been properly checked and passed before issue.

We now come to the pith of the subject, and that is—what system of inspection is to be used and how it shall be applied.

In any case it will have to be well supervised by a Chief Inspector, who should be directly responsible to the management, and it must be agreed that his responsibilities are great and that the success of the system will depend very largely on the personality and broad-mindedness of the Chief Inspector. On the other hand, a Chief Inspector who is not out to help the production departments, to work with them instead of against them, and above all be scrupulously fair and consistent, is not worth his salt, no matter what his qualifications or experience may be.

Owing to the cost of transport in the factory it is very often not convenient to have a Central Inspection Department through which all the work can be passed on its way to stores, and further, in a number of factories which have been extended from time to time, it is very difficult to arrange for a suitable position, and it is good practice under these conditions to arrange for the inspection to be done as far as possible in or near the shop in which it is produced. This is also an advantage when dealing with rejects, as they can be sent back for rectification easily and quickly and with a minimum amount of paper or clerical work, and when it is remembered that the Inspection Department is in most cases responsible for checking the quantity of work in each consignment and the signing of bonus or piece work tickets, and the booking of the work to the next department or stores, as per layout, it will be appreciated that the clerical work of an Inspection Department is a considerable item.

The proposed methods of dealing with the work will then be as follows :—

(1) Tool Inspection.
(2) Raw Material.
(3) Work in Progress in Machine Shop.
(4) Assembly.
(5) Final Inspection and Testing.

(1) *Tool Inspection Department.*

In any factory of reasonable size and with its own tool room it is essential to have a Tool Inspection Department, and even if it

only boasts of one man he should be entirely independent and responsible only to the Chief Inspector.

All tools should be inspected and passed before being issued for use. When the tools are made to tool drawings the Tool Inspector should check the tools also to the components drawing, and satisfy himself that they are accurate, will function properly, and that they will produce the parts correctly.

No tool should be submitted for inspection unless accompanied by a sample produced on the tools, and particular attention should be paid to clamps, locating pins, stops, chip and dirt clearances and extractors.

It should also be examined to see that the location of the piece is from the properly dimensioned point, so that the production will be uniform, and that any variation in the size of stock is catered for in the case of press tools, etc.

The Tool Inspection Department, if of modest dimensions, should at least be supplied with a good set of standard blocks, and the simple type of equipment for measuring screw threads. All gauges should be periodically examined and worn ones replaced.

The view room or floor inspector should notify the tool inspector of any tools that are not producing satisfactory work, and these should be recalled and re-examined.

It should also be the duty of the Tool Inspection Department to withdraw from circulation any jigs, tools, or gauges that have been affected by alteration to drawing, and see that the necessary modifications are put in hand.

For convenience it is advisable to have this department as close to the tool room as possible, so that the tool room foreman can have any work he considers necessary checked before hardening : this is very useful when dealing with men who have recently been engaged in the tool room and whose reliability is unknown.

(2) *The Raw Material Inspection* should, wherever possible, take place in the receiving department, or in a special department attached to it, so that it can be handled immediately the material is delivered, and any that is not up to the required standard can be rejected at once, and only the good material passed to stock.

A proper reject note will have to be designed, suitable for the factory concerned. The inspector in the Raw Material Inspection Department will be responsible for seeing that each note is properly filled in, giving particulars of consignment, quantity, name of supplier, work order No., etc. It should be printed in manifold so that one copy is retained in the book for reference, and one copy each for the Purchasing Department, the Progress Department, and one to be returned with the rejected material.

No material should be rejected unless the notes have been signed by the Chief Inspector, and this should be done every day, so that the department may be kept clear.

With regard to castings, stampings, or material ordered to special size blanks, it would usually pay to supply gauges for any important dimensions, so that the suppliers know exactly what is required. Further, I should like to mention here that in my opinion there is not sufficient attention given to the practice of sending a representative of the Inspection Department to see a supplier when a reasonably large order is placed for castings on special parts. It is a very easy matter to settle all kinds of little queries that crop up, if the supplier can discuss the difficulties of manufacture with an authorised representative of the Inspection Department, and a few shillings spent on railway fare and half an hour's chat around a particular job will often save weeks of delay in production due to the rejection of material that could have been avoided.

Also, in connection with the raw material inspection I consider it advisable for the Chief Inspector to be held responsible for the dictating of letters to suppliers concerning any technical details, but such letters must, of course, be sent through the Purchasing Department.

There will always be cases where material is supplied that is not correct, but is so urgently required that it cannot be sent back. Where this can be corrected by means of an extra operation, it will be preferable to have this operation carried out before the material is sent to stock, so that it can be dealt with in the ordinary way when it is issued to the shops; it will also enable the cost of such work to be ascertained if it is desired to emphasise the gravity of the fault to the supplier.

If an extra operation is not necessary, and only special attention required when machining, a note explaining the trouble should be sent to the machine shop foreman when the Work Order or Production Order is issued. If there is a larger quantity of sheet metal being used, a proper testing machine will be a great help if the initial cost of the machine can be met, as it is very difficult to test this class of material without a machine, particularly if of bending and drawing quality.

The inspection of fine wires will also need specially trained inspectors if the requirements are of an exacting nature, and there is any quantity to be dealt with. It will be the duty of the inspector in this department to see that the proper identification marks are put on every reel, so that they can be returned to the respective suppliers for credit. It is also advisable to use a code of identification marks in all cases where similar materials are obtained from different sources.

In the case of tool steel or special alloy steels, these should be painted for identification purposes under the supervision of the Raw Material Inspector, before being passed to stores.

If the firm is in the habit of buying machined parts from out-

side suppliers, I am in favour of such work being sent to the view room for inspection, where they can be dealt with as a routine job with suitable inspectors.

(3) Coming to the work in progress in the machine shop, there will probably be many different opinions as to the best way of dealing with it economically. My experience has been that the best method is the use of floor inspectors, and it is very satisfactory, but they will have to be very carefully selected and supervised.

A great deal of tact is necessary to create a proper understanding between the floor viewers and the machine shop foreman, and it must be definitely understood that the presence of a floor inspector does not in any way relieve the foreman of his responsibility for bad work or scrap. The number of machines that can be looked after by each inspector will depend on the nature of the work, and whether it is being produced by automatics or hand-operated machines.

Fifty machines can be looked after by a good floor inspector if the jobs are long running ones to fairly easy limits, but the number will have to be reduced very considerably if he is dealing with a lot of short jobs and tighter limits.

The main duty of the floor inspector will be to see that no machine is allowed to run until he is quite satisfied that the first few parts produced after setting up are well within the limits and quite satisfactory for finish, etc.—these parts should be produced by the *operator* and not by the setter.

If the machine shop is laid out in sections—such as drilling section, milling section, etc.—all the operations that are in sequence in one department can be dealt with by the floor inspector, and the work should then be sent to the view room, together with the bonus or piecework tickets for each operation that has been done.

It will generally be found that except for special dimensions which are to fine limits the work can be dealt with on a percentage basis and counted for bonus or piecework. Quite a small department will be sufficient, as most of the work will have been done in the shop, but as scrap records will probably be required, and the quantity passed will have to be recorded, it is more convenient to do this in a separate section than in the shop.

It is also important that the machine shop foreman shall be supplied with an up-to-date daily list of scrap from his department.

I have found it good practice to have the scrap laid out on a special bench set aside for the purpose, and divided into separate parts for each section of the machine shop. This should be looked over at a definite time each day by the foreman and floor inspector and then cleared to make room for the next day's work.

This method ensures that all concerned are familiar with what is happening, and once it is running takes very little time.

In a good many shops there are still signs on the part of the machine shop foreman and chargehands that the Inspection Department is only there to upset promises to the Progress Department, and during the arguments on rejected work it is too often stated that although the limits have been exceeded it is good enough for the job.

If this is really the case the limits should be revised, but it does not alter the fact that the job is not as big, and that the machines have not done their work properly, and it is their duty to notify the Chief Inspector of their troubles to produce work to the required limits, so that an investigation can be made to see which can be altered: the limits? or the method of manufacture?

It will considerably help the production if a good feeling and co-operation exists between the Inspection Department and the Production Department, and there should always exist a willingness on both sides to give and take.

I have often said that it is much easier to pass a job than to reject it, but there are very few excuses for an inspector if he passes faulty work, but it is a fact that a lot of viewing is not merely a question of seeing if the job is right, but one of seeing if the job is too bad to use.

There is only one thing that is responsible for the greater part of the trouble in the manufacture of this class of work, and that is screw threads, and as they are usually B.A. or B.S.F. sizes, there is very little tolerance to play with, and a lot of this is often taken up by the inaccuracy of the taps and dies. Fortunately, in the last few years we have been able to obtain better quality supplies, but it is still advisable to get both taps and dies from the same manufacturer.

If trouble is to be avoided in the Assembly Department, the Inspection Department and the Production Department must be supplied with good and accurate screw thread gauges.

It will be seen that this is really a continuation of the floor inspection system and the view room system, but it has been found very satisfactory.

The system where all work is sent to the view room after each operation is too elaborate unless the work is of such a nature that it must be thoroughly inspected 100 per cent. at each stage, and, further, it adds considerably to the time taken for the work to get through its sequence of operations, and the number of parts in progress will be more than if the combined system is adopted when there are several operations per piece.

I have not taken any examples of view tickets or records, as they will always have to be designed to meet the local condition

of the factory, and a view ticket that is successful for all purposes in one factory will often prove to be worse than useless in another factory, even if similar work is being done. Further, my object to-night is to discuss the minimum amount of inspection necessary rather than the ideal methods, which can only be adopted on better class and less competitive work.

(4) The Assembly Department can be dealt with in a similar manner to the machine shop, except that the Final Inspection and Testing Department will take the place of the View Room. Usually the assembly is split up into a number of partial assemblies, each consisting of a number of operators who are working in a gang, so that each stage of assembly is finished as it reaches the end of the bench. If sufficient room is then allowed for, say, two hours' work to accumulate, a floor inspector, or floating inspector, as they are sometimes called, can pay a periodic visit to each section, and view and pass the work on to the next stage or to the stores, whichever is called for on the layout. This method will also facilitate the watching through of any experimental batches of work or the effect of changes to drawing or design.

If a certain job needs to be examined 100 per cent. at a stage when it is only, say, half-way through, I have found it a good plan to put a girl in the proper place in the gang to deal with it if there is sufficient work involved to make it a whole time job. The floor inspector will be able to supervise the girls on such work in the course of his ordinary duties, but it is as well to make it quite clear that for shop discipline, all such viewers or inspectors are under the control of the foreman in charge of the shop.

As mentioned earlier, I am strongly in favour of issuing a small percentage of small screws, etc., in excess of the requirements on work of this nature, particularly if the stores issues are strictly dealt with, as it is obvious that if you are handling Nos. 6, 8, and 10 B.A. screws and nuts, and only 1,000 are issued where 1,000 are required to be used, it will need more than ordinary supervision and good luck to finish off the last fifty, and the trouble of requisitioning replacements from stores and the delay on the bench will be far more expensive than the few extra parts issued, and 2 or 3 per cent. will usually cover the shortages due to losses and screws which have bad threads, no slots, etc.

These additional parts must, of course, be properly catered for in the manufacturing programme, and included on the material sheets so that they can be included in the cost of the article.

(5) The Final Inspection and Testing Department should be, wherever possible, a separate department, and should be properly enclosed and locked when not being worked in. When the assembled instruments have been sent to the Final Inspection Department, they must not be allowed to go back to the shop for

any alteration or rectification unless they are sent with a reject label showing exactly what is required to be done to bring them up to standard, and great care should be taken to see that when such rejects have been corrected and returned, they are not again rejected for faults not previously mentioned.

This causes a lot of bad feeling and makes co-operation difficult, and it is not in my opinion right to reject an assembled article for the first fault that is found and ignore the possibility of others existing unless they are dependent on the fault mentioned.

Where there are excessive faults on a batch of work, the inspection of it should be stopped and the foreman responsible called in, when it will probably be agreed to take back the whole of the batch and go over it again completely before it is re-submitted.

It is most essential for a Testing Dept. that any equipment they need to carry out the required tests should be supplied and it should be of good quality.

If a number of similar instruments are in use a reliable standard should be supplied for checking purposes, and this should be done at regular intervals and any faulty instruments re-calibrated. A lot of the testing on electrical instruments requires an almost soundproof department, and as these can so easily be constructed it is false economy not to do so. The extra speed at which the inspectors can work with confidence will soon repay the cost of such cabinets.

The use of inspection labels signed by the inspector who passed the work and the records of work passed to stores are matters of routine that need not concern us unless any points are raised in the discussion.

In conclusion I hope I have made it quite clear that these methods of dealing with inspection are not intended to apply to the manufacture of automobile engines or the heavier side of engineering, but to the large number of small factories that are devoted to the manufacture of motor car accessories, electrical accessories and instruments, and radio instruments and components, which are in most cases highly competitive, and yet require a certain amount of inspection to enable them to be produced economically and of the requisite quality and finish.

Discussion on Mr. A. Butler's Paper Entitled "Inspection Methods."

MR. WARING-BROWN (Member of Council), in opening the discussion, said that they had to thank Mr. Butler for a very clear exposition of what inspection should be. Most of the points mentioned in the paper were not really open to argument; they were just a clear exposition of what was necessary. There was, however, one point, when Mr. Butler had said that his system was intended for small works. His idea of a small works was that the number of inspectors was usually one, and, at any rate, he did not think a small works would be able to employ the staff which would be necessary for all the different jobs which Mr. Butler had enumerated. The cost of inspection was, of course, frequently very high, and in a small firm it was a serious item to be considered. It seemed to him that the cost would be frequently better borne by eliminating some of the older plant and putting in some that would not produce bad work.

He would like to emphasise in particular one suggestion made by Mr. Butler, *i.e.*, that the chief inspector should check up the limits from drawings, because he found that the drawing-office frequently put on limits which entailed much unnecessary work. There was also the question of distinguishing material, for which Mr. Butler had said, in the case of raw material, it was necessary to paint it. He found, however, that paint was soon rubbed off, and it was essential to mark the material with a code number in a place where it could not be machined off. In an actual case which he had encountered recently in a large automobile factory, a number of ball joints had broken when the cars were on the road. These were inspected, and it was found that the wrong material had been used. Consequently, 10,000 ball joints were scrapped, although it was afterwards found that 5,000 of them were all right. This loss was entailed simply because there was no proper method of marking material, and because a few were wrong it was assumed that the whole batch was wrong.

He noted that Mr. Butler made a point of inspecting tools when they were new. In his opinion, the chief trouble with tools was in inspecting them after they had been used. Large firms naturally had a method of periodic inspection, but he was afraid that in the small works the only inspection tools ever got was when they were new and when they were scrapped or worn out.

MR. BUTLER, answering Mr. Waring-Brown in the Chair, said that before proceeding further he would like to correct the impression that the methods of inspection which he had described were intended for small works. They were not. They were for a works of moderate size manufacturing small parts, which was a different proposition. In the small works to which the Chairman had referred, inspection was usually done by the foreman or by the proprietor himself, and probably was keener then than it would be under other conditions. The cost of inspection was, of course, one of the reasons for dealing with the subject in the paper, but there were many people who had the idea that inspection was waste of money altogether. Whilst it was quite possible to have too much of it, he himself regarded it as a very good investment.

With regard to the methods of marking steel, he had tried both and now generally used both, but he had not found much difficulty in preserving the paint on the steel. He had found that if he used a code number alone he could put it where he liked, but the very first time anyone cut a piece of steel off the code number was lost. It seemed almost as if people would cut a piece out of the middle of a bar for the purpose. With regard to painting, he insisted upon bars being painted throughout the entire length, otherwise a man taking a piece of steel would cut off the piece with the paint so that he knew what he had, but no one else knew what was left. Generally speaking, he had found that painting all along was quite a satisfactory method. An additional safeguard was to stamp a code number on one end and try to persuade the men in the stores not to cut that end off.

With regard to tool inspection after tools had been in use, he had tried many systems, but had never evolved one that was satisfactory. With gauges one could insist on having them sent back each week for checking, and in the case of a gauge there was some hope of getting it replaced if anything went wrong, because it upset the whole process of manufacture. But if a tool were worn, unless one could satisfy everybody that it was worn so badly that it was impossible to use it any longer, one could never get it repaired. All things considered, he was of the opinion that the method suggested in the paper was perhaps the easiest and cheapest way out of the difficulty, *i.e.*, that as soon as the floor inspector, or even the foreman or the viewer, found that work was coming out unsatisfactorily with unnecessary variations, he should send the jig back to the tool inspector, and if it were found to be wrong have it put right immediately and stop all work until it had been done.

[With regard to the question of marking material, an interesting method which would appear to obviate all possibility of confusion is adopted by a well-known automobile factory. This consists in

using a code roll or disc stamp on the arbor of a small horizontal milling machine. The necessary lettering is cut on the periphery of the disc, and on the worktable of the machine are arranged two lengths of channel iron forming an approximate guide for the bar. Actually, the bar is supported on rollers on the underside to minimise friction to the greatest possible extent, so that the bar travels along merely by the rolling action of the circular stamp. An additional vertical pair of rollers are provided to centre the material accurately in relation to the stamp, these rollers being operated by a self-centring mechanism controlled by a handwheel. The required pressure is obtained by raising or lowering the worktable of the machine, and the device is designed to cover all sizes of bars in the works. By this means all bars are permanently marked throughout the entire length.—EDITOR.]

MR. MANTELL (Member) said he quite agreed that the inspector should co-operate with the drawing-office in checking up limits. The more co-operation it was possible to obtain in this direction the easier would the progress of the work become. He did not, however, agree with throwing the onus of tool design on to the tool inspector. This was what it amounted to if the inspector had to look for faults in design after a jig was made, and in his opinion that was tackling the problem at the wrong end. The inspector was already sufficiently unpopular without having to face the wrath of the tool design department.

Regarding the location of the inspection department, Mr. Butler had mentioned that if it were near to the department where the work was produced there was a saving in clerical labour as far as rejection notes were concerned. He could not quite see that, unless the viewer or inspector went along to the department at fault when something went wrong, which did not seem quite the right procedure. He thought the rejection note was essential, especially to the management in helping to locate trouble.

He would like Mr. Butler to elaborate on the subject of thread inspection if he would. Next to gears, in his opinion, it was the one that was most open to discussion in the works. There was the question of obtaining taps and dies from the same manufacturer. That did not seem to help very much when one bought screws outside, and the holes were tapped in the works. He thought they would agree that a very fine organisation existed in the British Engineering Standards Association, and, as they had laid down rigid specifications for screw threads and taps and dies, he thought a lot of trouble which was experienced to-day would disappear if the B.E.S.A. recommendations were more generally adopted. On the question of gauging wire, he came across an illuminating instance only a few days ago when visiting the office of a certain works official. He (the official) had in one hand a coil of wire about 46 gauge, and a micrometer in the

other, and he was cursing the inspection department very heartily because he said the wire they had rejected as undersize was oversize. A minute or two later the inspector in question entered the room, measured the wire, and adhered to his original comment. After some argument it appeared that the inspector had measured the end of the wire, where it had been broken; here it was stretched and naturally undersize. The man who insisted it was oversize had measured higher up the wire, and had actually measured over the enamel. It occurred to him at the time that it was somewhat difficult to measure such fine wire accurately, as in scraping off the enamel one would almost certainly scrape some of the wire with it, but it should be possible to measure wire electrically by taking a definite length and measuring the resistance.

MR. BUTLER said that, with regard to measuring wire, if one measured a piece of 46 wire, which he thought was 0·0024in. diameter, and measured the end where it had been broken off and stretched, one could hardly expect accurate results. In any case when a wire was tested, it was always the practice to pull off a yard or so first—that is, if the wire department was being properly supervised. There were, in fact, two or three tests which were necessary on wire of that description. First of all, an elongation test was made, and that to be reliable must be carried out twice to a reel of wire. Probably one also tried a resistance test, although, as far as radio work was concerned, many resistance tests were simply waste of time. To remove the enamel the apparatus used was often the bottom half of a shilling bicycle lamp. The enamel was simply burnt off, and there should be no difficulty in measuring it accurately. There was a wire measuring instrument on the market, but, unfortunately, it cost about £80, so that very few people used it. There were many points to consider in connection with enamel on fine wires. The greatest trouble that they experienced was that it varied widely in quality. Some enamel was quite hard and brittle, so that it would flake off, and some was so soft that it peeled, and he was afraid this was just one instance where the American had us badly beaten. Probably the chief reason was because Americans used an enamel with a gum base, whilst our enamel had an asphalt base.

With regard to the tool inspection department and the responsibility for the design of tools, naturally it was the wrong time to query tool design after the tools had been made, but whoever was responsible for the design of tools, if a mistake were made, it was surely better to find out at the wrong end rather than to let the tools go into the shops. In any case, it was impossible to inspect a tool before it was made, and there were very few tool-room foremen or tool designers who would be willing to lay their designs open to the criticisms of the inspector before they went into the shops. We were usually told that there were enough

fools already who could criticise without adding to the list officially. It was, however, the little points that the inspector could watch. Although the design of a jig might be perfectly sound and the jig might be well made, often the man who made it did not take into consideration that it had to be handled quickly when it got into the shop. One would find, for instance, that the clamps were a beautiful job, but so stiff that the poor operator would have very sore fingers before he had used them for an hour. It was the position of the clamps, the locating faces, the size of the pilot bushes, and matters of that description, that were referred to mainly as being desirable to check. All the little points that could be altered by just a few minutes' chat with the inspector and the foreman counted for quite a lot. Probably, however, the best method for dealing with tool design and inspection in factories employing from 1,500 to 2,000 hands on small work was by means of a committee. Some years ago he had been in the habit of arranging every new job in that way. It did not take perhaps more than a couple of hours for the shop superintendent, the tool-room foreman, chief inspector and the chief tool draughtsman to go through a rough layout, and decide the type of jig and fixture that was wanted for each operation. Moreover, it had usually been his practice to insist, if there had been any argument about the type of jig that was to be made, that the machine shop foreman who had to do the job should have a say in the matter. He thought that was an important point. Since that time he had found in other factories that if a machine shop foreman had had some say in the type of jig to be used, he would usually say it was a success and make it so when he got it. On the other hand, if he were forced to use a type of jig that he did not want, and it turned out a little awkward to operate, it was a long time before one heard the last of it.

With regard to screw threads, he hardly thought he dared elaborate very much on that. They had previously had before the Institution one or two good papers specialising on the subject, but he had usually found on small work that if a report of trouble came through from the assembly department it generally had something to do with small screws. In one particular factory with which he was connected he could almost guarantee that if trouble in the assembly department was mentioned it was not only screw threads, but it was 4B.A. screws, and it was a long time before they got over the difficulty. Usually they had avoided trouble by buying taps and dies from a really good maker, obtaining both from the same supply and using standard gauges for setting and checking purposes. When using plug and ring gauges, however, there was the difficulty that they could not be used very much before they began to show signs of wear, but if one could persuade the management to equip the shops with the Wickman

type of gauge it was the most satisfactory that he knew of at the moment, and then most of the troubles with gauging threads would be overcome. This method of gauging had been very fully explained by Mr. Wickman himself. Generally speaking, however, there were very few firms even to-day who were properly equipped for the measurement of threads and screw gauges. Also in this respect the measuring appliances were usually ahead of the manufacturing equipment, and he did not think that many of the more scientific types of apparatus were applicable to the class of firm with which he was dealing in the paper.

Mr. Mantell had remarked that buying taps and dies from the same maker did not improve matters when screws were bought outside from another source of supply. This was true, but he thought that those of them who had experience on small work would agree that whilst one could buy screws a lot cheaper than one could make them, those that they bought were far inferior to those they could make. They could hardly expect anything else, because if they started to quibble about any little inaccuracies in bought screws the maker would turn round and say, " Well, what can you expect for 1s. 3d. a gross? " and there was no further argument. With reference to buying screws to B.E.S.A. standards, the same trouble would arise. If one specified such screws to many suppliers they would probably write back and ask what they were, and if they knew they would certainly write back and say that they would be perfectly willing to supply such screws, but they would cost so much a gross more. The standards were certainly a very fine thing, but they were hardly practicable in the face of competition on radio apparatus work, and he had not found it necessary to adhere rigidly to them even on better work for Government departments.

Mr. Whitaker (Member) said that he was interested in the question of general inspection. He thought perhaps in the paper the tendency was rather to overdo the duties of the chief inspector. In dealing with the suggestions regarding the viewing of designs for castings, perhaps the best man for the purpose would be the chief planner, and if he could get round and see the work in the course of design he would serve a very useful purpose. He thought also that the planner might be made responsible for fixing limits, as he would generally see more clearly the aim of the designer and the possibilities of working within the limits, and would be able to examine the work from the point of view of tolerances far better than an inspector.

In the matter of inspecting tools after use, there was no excuse whatever for a foreman to go on producing bad work for the simple reason that he was using bad tools. If the floor inspector were alive he certainly should take up the work almost as soon as it left the machine and probably pick out the fault which was

developing in the tool, so that after informing the tool room inspector it could be remedied almost immediately.

He would like to express his objection to the formation of committees for settling the design of tools. He had had some experience of committees, and they were a source of continual delay; directly a discussion started with a committee it soon became absolutely irrelevant to the points in question. In his opinion, if the chief planner, or the chief tool designer, had the subject at heart, and he was a competent man, he should be able far better than any committee to arrange the design of the tools and cope with the general manufacture of the work. As regards consulting the foreman, he did think that was a most important point, and no planner was likely to be really successful without doing so. He must secure the co-operation of the man who had to carry out the work.

MR. BUTLER, in reply, said he was pleased Mr. Whitaker had raised the question of inspecting raw material. He distinctly did not agree with the suggestion that the planning department should be made responsible for that. He was responsible for laying out the work and the sequence of operations, and, generally speaking, he had enough to do. He had in mind many points in the raw material inspection department that did not concern the planning man in the least. For example, the planning engineer was not directly concerned with the tensile strength of steel. All he required to know was whether it was high tensile steel, and he knew then what speeds or feeds he must allow to cut it, but actually whether it was 48- or 52-ton steel did not concern him a great deal, but it was a vital point to the chief inspector. Then, again, he believed it was advisable to have the inspection entirely under one man, and one certainly would not expect the chief planning man to have much to say about the quality of the work after it was assembled. Actually, of course, the chief inspector had very little to do with raw material other than signing reject notes. He simply chose a good all-round inspector who worked to instructions, and, generally speaking, the main duty was to check material roughly to size within commercial limits and to see that it was not badly bent or in widely varying lengths, whilst in the case of sheet material he could only measure it for thickness, unless he was equipped with the proper machine for testing sheet metal. On castings the more general inspection consisted in looking over them to see if they had been properly fettled, if they were sound, and an occasional check for weight, size, etc. If there were any really important dimensions they should be dealt with as mentioned in the paper, *i.e.*, a gauge should be supplied to the raw material inspector and to the foundry.

With regard to Mr. Whitaker's objection to the use of com-

mittees on tool design, he agreed with him in a good many cases, but he thought that, as in all other committees, much depended on the chairman. If Mr. Whitaker had come across a disinterested type of chairman who let members wander off the subject, he could hardly blame the principle he had in mind for that. Also Mr. Whitaker had admitted that it was a good idea for the chief tool designer to consult the machine shop foreman, and if he had admitted half the principle he, Mr. Butler, did not see why he should object to the other half. If the committee consisted of the people he had mentioned, namely, the works superintendent, the production engineer, the chief tool designer, the chief inspector, the machine shop foreman, and the tool room foreman, and if the production engineer who usually supervised and controlled the drawing office, tool design layouts, and so forth, were in the chair, one had a committee that could be handled quite easily by anyone who had the necessary ability to fill the office of chairman. The procedure then was simply that after the job had been roughly laid out by the tool designer it was submitted to the committee, and discussion only arose when the tool designer had suggested any method that a member of the committee did not agree with. He had adopted that system for some years, and had never experienced any delay resulting from it. On the other hand, the reverse was the case, because if everything were left to the chief tool designer he, like the rest of us, was not infallible, and the various people concerned were not in a position to know exactly what had been done and what was contemplated. After a committee lasting a couple of hours, however, everyone had a clear idea as to what was required.

MR. WHITAKER thanked Mr. Butler for his remarks, and whilst he was willing to admit that one could get through a great deal of business by means of a committee in the hands of a strong, scrupulous chairman, there were generally so many minor points raised by these committees. Each member had numerous technical difficulties that he wanted to bring out.

With regard to the inspection of raw material, he had intended his observations to refer to Mr. Butler's remarks with reference to interviewing the foundry to effect minor improvements to facilitate production. The planner would probably foresee many of the minor difficulties and so be able to arrange with the foundry to get the best casting for tooling and machining purposes.

MR. BUTLER said that personally he did not think it mattered greatly who the representative was who was sent out to interview the foundry with regard to a casting, whether it was an inspection man or a machine shop foreman. He had employed both, and so long as it was a man who knew the requirements of the job and who had the authority of the inspection department behind him, that was all that was required. But he thought Mr. Whitaker

had missed one of the important duties of the planning department if he suggested that it should be necessary for him to interview the foundry with a view to effecting improvements on a casting. The planning department should, before issuing any drawings to the foundry, make quite sure that the casting was a practicable one with suitable points for locating, holding, etc.

MR. WARING-BROWN, concluding the discussion, said he would like to pass a vote of thanks to Mr. Butler for his paper.

MR. BUTLER said that what little he had done had been quite a pleasure, and he was rather sorry that there was not more adverse criticism. There was so much of an adaptable nature about inspection generally that he felt sure that one or two of their members could have suggested other and better methods.

CORRESPONDENCE.

The Institution as a body does not necessarily identify itself with the views of members expressed under this heading, nor can responsibility be accepted by the Institution for statements made by individual members. The Editor reserves the right to omit any portion of a letter if it is considered desirable to do so.

The Registration of Engineers.

SIR,—The Editorial in the last edition of the Journal of the Institution is very enlightening, especially when compared with the attitude of some of the senior Institutions, and the remarks of the President in December should be read once more by every member.

As a member of both the Institution of Production Engineers and of the Society of Technical Engineers, who were responsible for the Bill now before the House, I would like to say a few words about the latter body for the interest of those to whom the Society may be but a name. As I no longer hold any office in the Society this is not an official communication but the opinion of a private member.

Perhaps the fact which has most militated against the numerical strength of the S.T.E. is that we are registered as a Trades Union, and the term has come to mean a body of advanced views which is naturally affiliated to the Trades Union Congress. As a matter of fact, the Society of Technical Engineers put up the most potent opposition to the attempt of Mr. G. D. H. Cole some years ago to rope all the " Black Coat Unions " into the Congress. At this time he was successful with regard to the National Union of Clerks, the Draughtsmen's Association, the Railway Clerks Association and some others.

Remaining out are the S.T.E., the Electric Power Engineers, the British Association of Chemists and others, amongst whom it is hoped to form a combined consultative body through which each can work for the benefit of the technical man and the Industry of the Empire. The latter is important and is not lost sight of in the formation of the S.T.E.

A resolution has passed all Branches by which we bind ourselves to take no action which may adversely affect the Industry concerned or the trade of the country in general. To put it bluntly, we do not believe that the strike weapon is either advisable or necessary to the furtherance of our aims.

Let it also be noted that the Whitley Councils and other such bodies will accept membership from registered Trades Unions only and that any body not so registered must pay Income Tax on their funds and are liable to be proceeded against for one thing and another, to the utmost limit of their possessions. In view of these facts there was nothing for the organisers of the Society to do but register themselves.

I do not want to list all the things we are attempting to do on behalf of the technical man; the main one, of course, is to raise his status, and if possible his salary, but in pursuit of either of these we are committed to avoid making common cause with either organised labour or with employers' federations.

Those who are interested may obtain all particulars from the Secretary at 102, Belgrave Road, S.W.1.

The present Bill is an indication of what we are about; we have an Unemployment Insurance Scheme, an Employment Bureau, a Patents and Agreements Committee, a Technical Information Bureau, and are hard at work on the question of Superannuation.

A man to-day has few chances of discussing burning questions of Industrial Politics, but these are vitally important to all of us, sandwiched as we are between two opposing forces. We claim to represent the Third Party in Industry, tied to neither Capital nor Labour but seeking to advance the interests of the Engineer by the methods one would expect from a body of educated men.

Party Politics are most definitely barred; we think that these are as much a private matter as is a man's religion. If this fact were generally recognised and all unions turned their attention to the suppression of industrial strife we would not be in the unhappy state that we are to-day.

N. GERARD SMITH.

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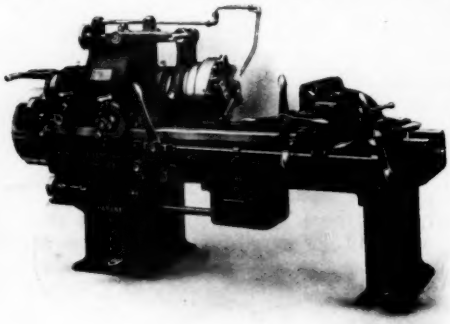

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